NSRL Beam Development Studies Plans: NSRL 7

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Anyone else?

Schedule

1. Friday, Oct. 14 (Chlorine)
   - 550 MeV/n Chlorine development
   - R-Line documentation, emittance, etc.
   - Tune Measurements
2. Monday, Oct. 17 (Iron)
   - Cycle switching development
   - Solar Particle Simulator
     - Time of flight measurements
     - energy calibration
3. Tuesday, Oct. 18 (Iron)
   - Booster Orbit Studies, Extraction bumps
   - Fast extraction to R-Line

When Time permits: 20° bend as beam switch

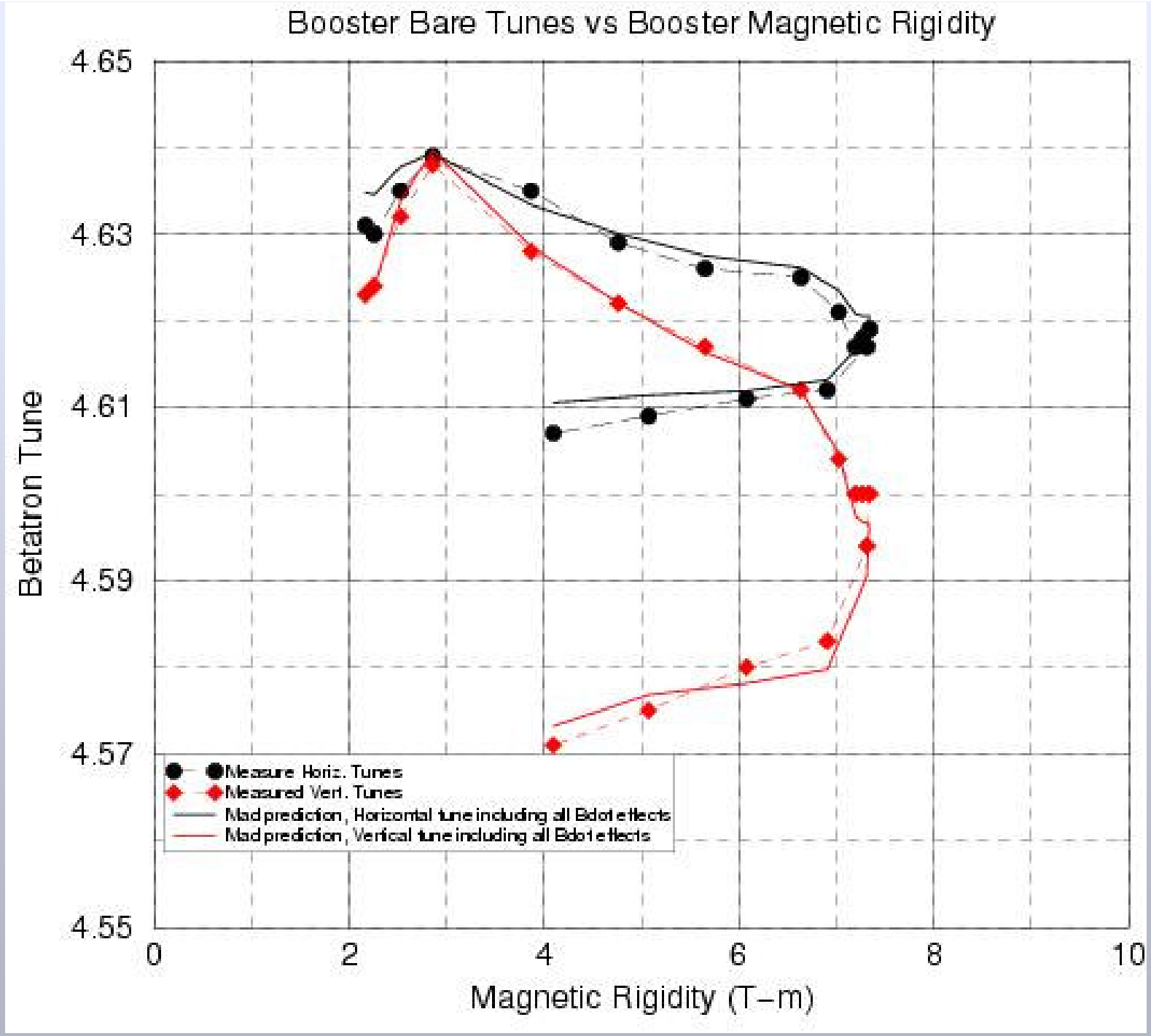
Tune Measurements Study Plan

Basic plan is to measure the bare Booster tunes throughout the cycle for 3 different magnet cycles, up and down the magnet cycle ramp (requires de-acceleration to work).

1. Pre-Study
   - Ensure 914 Scope configuration is correct
   - Check tune kickers (on and working)
   - Test new LabView interface in MCR
   - Establish RF configuration for de-acceleration.

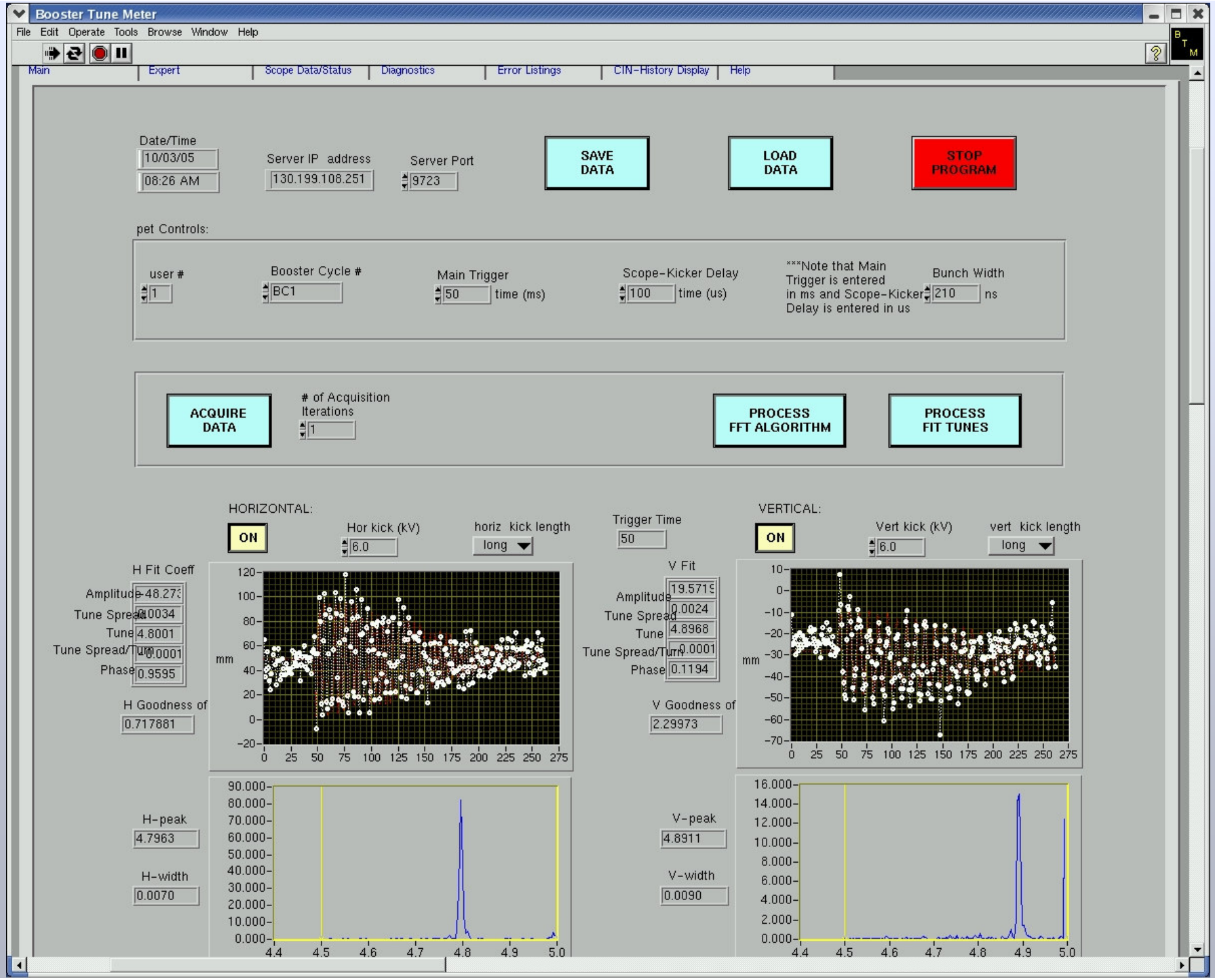
Tune Measurements Study Plan

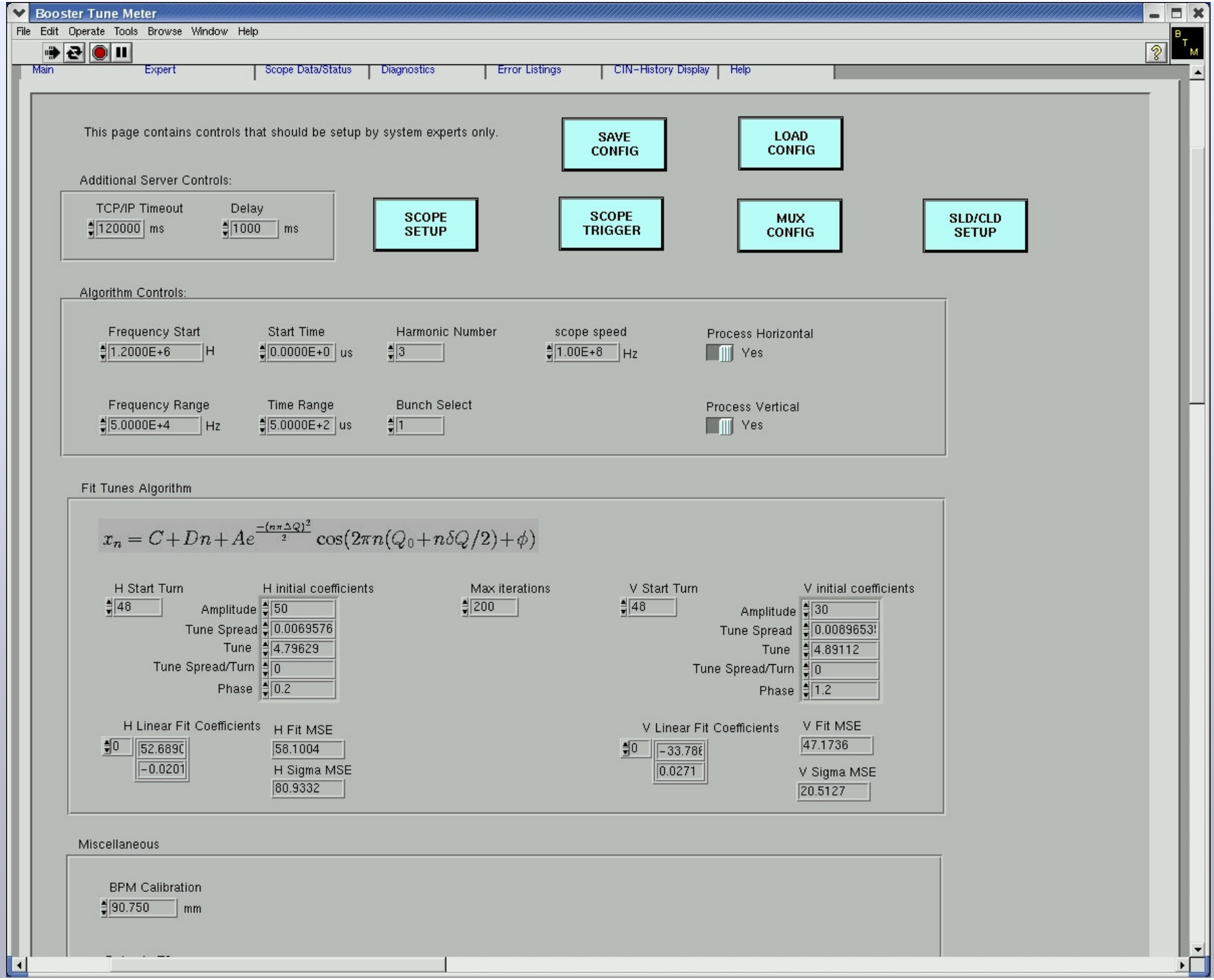
2. Study Plan
    1. In all cases we work with a bare machine. This means tune trim P.S. is on at 0 current everywhere and all sextupoles are either in STBY or on at 0 current.
    2. Develop 3 magnet cycles with beam accelerated and de-accelerated as much as possible.
        - 2 cycles are polarized proton cycles; 1 full B-dot, second at $\frac{1}{2}$ full B-dot. For these two cycles beam needs to be accelerated and then de-accelerated. (example on next slide)
        - 1 cycle is normal NSRL cycle, no need for de-acceleration for this cycle (no extraction).
    3. Using the new tune meter system measure at regular intervals throughout the cycle (about 20 measurements per magnet cycle).
    4. For a smaller number of points (4 or 5 per cycle) explicitly measure chromaticity.


Booster Bare Tunes vs Booster Magnetic Rigidity
Betatron Tune
4.65
4.63
4.61
4.59
4.57
4.55
0
2
4
6
8
10
Magnetic Rigidity (T-m)
Measure Horiz. Tunes
Measured Vert. Tunes
Mad prediction, Horizontal tune including all Bdot effects
Mad prediction, Vertical tune including all Bdot effects

Tune Measurements Study Plan

3. Documentation
    1. For each tune measurement
        - Save data from tune meter
        - Measure GC at each point
        - Measure RF frequency at each point (optional)
        - Note radial steering function
        - Measure Booster orbit for each point
    2. Document Ierr signal from tune trim power supply for each magnet cycle.


Booster Tune Meter
File Edit Operate Tools Browse Window Help
Main
Expert
Scope Data/Status
Diagnostics
Error Listings
CIN-History Display
Help
Date/Time
10/03/05
08:26 AM
Server IP address
130.199.106.251
Server Port
9723
SAVE DATA
LOAD DATA
STOP PROGRAM
pet Controls:
user #
1
Booster Cycle #
BC1
Main Trigger
50
time (ms)
Scope-Kicker Delay
100
time (us)
***Note that Main Trigger is entered in ms and Scope-Kicker Delay is entered in us
Bunch Width
210
ns
ACQUIRE DATA
# of Acquisition Iterations
1
PROCESS FFT ALGORITHM
PROCESS FIT TUNES
HORIZONTAL:
ON
Hor kick (kV)
6.0
horiz kick length
long
Trigger Time
50
VERTICAL:
ON
Vert kick (kV)
6.0
vert kick length
long
H Fit Coeff
Amplitude
48.273
Tune Spread
0.0034
Tune
4.8001
Tune Spread/Turn
0.0001
Phase
0.9595
H Goodness of
0.717881
V Fit
Amplitude
19.5719
Tune Spread
0.0024
Tune
4.8968
Tune Spread/Turn
0.0001
Phase
0.1194
V Goodness of
2.29973
mm
H-peak
4.7963
H-width
0.0070
V-peak
4.8911
V-width
0.0090


Booster Tune Meter
File Edit Operate Tools Browse Window Help
Main
Expert
Scope Data/Status
Diagnostics
Error Listings
CIN-History Display
Help
This page contains controls that should be setup by system experts only.
SAVE CONFIG
LOAD CONFIG
Additional Server Controls:
TCP/IP Timeout
120000 ms
Delay
1000 ms
SCOPE SETUP
SCOPE TRIGGER
MUX CONFIG
SLD/CLD SETUP
Algorithm Controls:
Frequency Start
1.2000E+6 H
Start Time
0.0000E+0 us
Harmonic Number
3
scope speed
1.00E+8 Hz
Process Horizontal
Yes
Frequency Range
5.0000E+4 Hz
Time Range
5.0000E+2 us
Bunch Select
1
Process Vertical
Yes
Fit Tunes Algorithm
$x_n = C + Dn + Ae^{\frac{-(n\pi\Delta Q)^2}{2}} \cos(2\pi n(Q_0 + n\delta Q/2) + \phi)$
H Start Turn
48
H initial coefficients
Amplitude 50
Tune Spread 0.0069576
Tune 4.79629
Tune Spread/Turn 0
Phase 0.2
Max iterations
200
V Start Turn
48
V initial coefficients
Amplitude 30
Tune Spread 0.0089653
Tune 4.89112
Tune Spread/Turn 0
Phase 1.2
H Linear Fit Coefficients
0
52.6890
-0.0201
H Fit MSE
58.1004
H Sigma MSE
80.9332
V Linear Fit Coefficients
0
-33.786
0.0271
V Fit MSE
47.1736
V Sigma MSE
20.5127
Miscellaneous
BPM Calibration
90.750 mm

Plan for NSRL energy scan studies, Oct. 17, 2005

8am(9)-12(1pm): Testing the new R line Manager with beam. Nick Tsoupas, Bob Olsen.

12-4pm (or finished): Testing energy scan application. Kevin (at times), Peggy, Kip, Paul

Approximate time for TAPE to change energies: 2 minutes
Adam will be collecting both Time of Flight data and Bragg curves at each energy step – approx. 5 min for each data set.

Pre Study:

1) Verify TAPE is ready to go
2) Setup loggers (Ion Chambers, Booster Intensities, R line magnets, d3, d6)
3) Investigate possibility for Booster radial measurements
4) Learn how to use Mountain Range program for frequency measurements

During Study:

1) Double check that we are working with the new Optics model.
2) Save archives and document starting setup.
3) Do scan – documenting each step "as is" – 10 steps in energy change ~1 ½ hours (allowing 10 minutes per step)
4) Do scan documenting each step and what changes are made to correct each step. – 10 steps in energy ~2 ½ hours (10 minutes per step + 15 minutes per step for corrections).

Documentation:

Tape will dump:

1) The energy we have scaled to.
2) Swic 302
3) Ion Chamber Gpms
5) Booster intensities Gpms

Additional documentation:

1) Mountain range pictures
2) Gauss clock up & down counts
3) Hall probe measurements
4) Spill Servo function
5) Radial measurement (if we find one)
6) Any changes made to improve the beam (R line magnet settings, radial steering function, D6, D3, Tunes…)

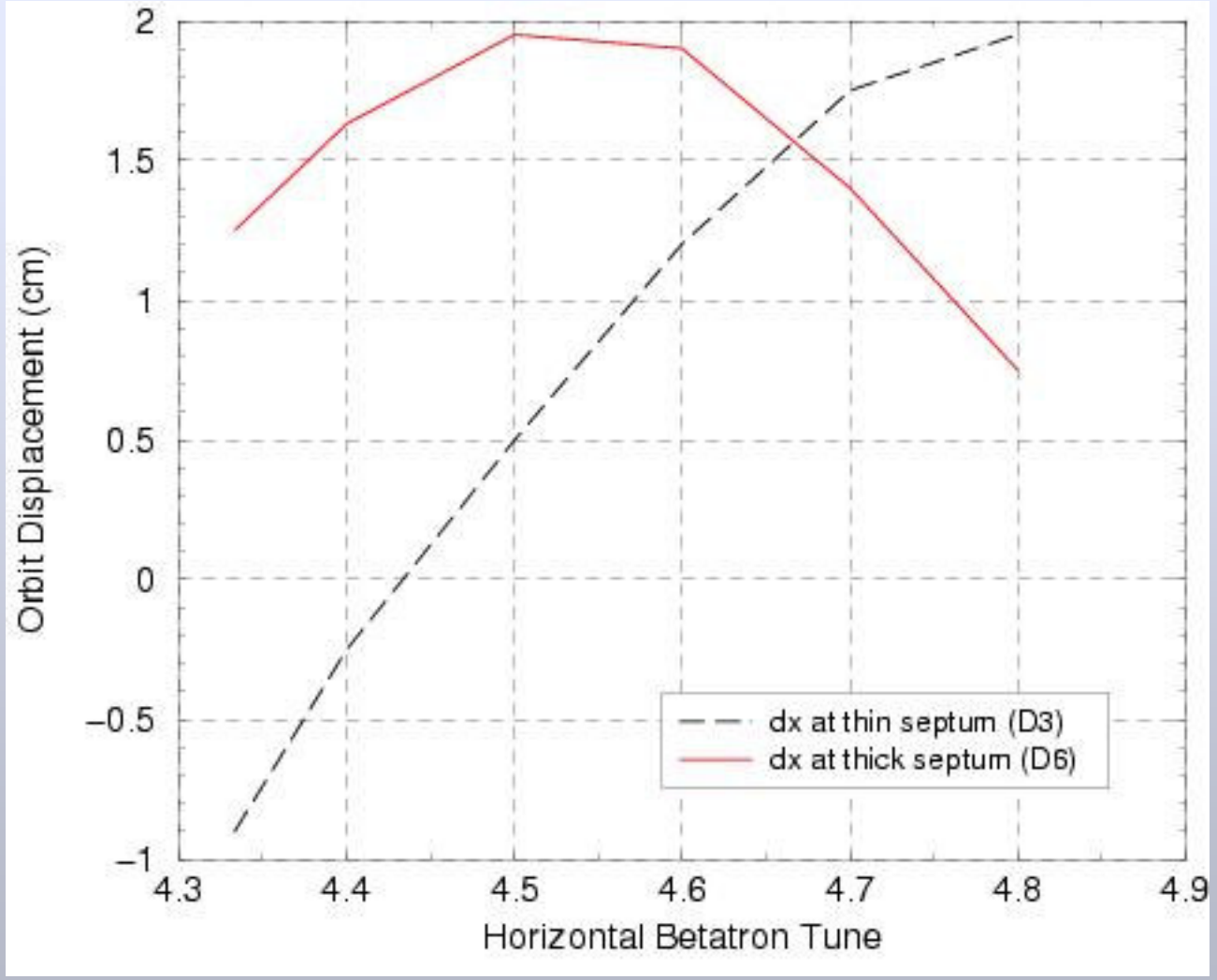
Post Studies:

1) Evaluate what item need to be put into the mix for energy scans
2) If possible make changes that can be tested the following morning
3) Generate a plot showing intensity at 302 vs energy for both a scan that has no manual corrections and for one that was corrected.

Booster Orbit Studies

- Lee Hammons Plan

Fast Extraction to R-Line



Displacement at D3 and D6 versus Tune, for a 2 mrad kick from F3 at 17 Tm beam rigidity.

Fast Extraction to R-line

Objectives:

1) Determine if beam can be extracted at d6 by using the kicker at F3.
2) If successful, try to quantify the extraction efficiency.

Instrumentation:

1) PUEs at D1, C3, C5, B6
2) WCM at E6
3) Booster Current transformers
4) Loss monitors
5) BoosterOrbitDisplay
6) D6 flag

Setup:

1) Ideally, start with a machine that is already running SEB to R line. That way the R line magnet settings, D3 and D6 are setup to bring beam down R line.
2) Adjust synch.st and Cogging Arm delay (Booster/Rf/BtaCogSync_Trigs) to get the kicker to fire on flattop. This should not be difficult since Cogging Arm is real time. Although there may be some maximum delay…
3) Synchro should be off. This requires Synchst on and synch_loop.st off. No COG event on Supercycle.
4) Set H tune to near 4.67. Resonance may be a problem here.
5) Set SEB bumps to make bump at D3 to outside with tune of 4.67. Otherwise, use nominal extraction bump. In either case, may want to check/adjust SEB bump to reduce residuals. Hopefully, OrbitDisplay will help with reduce residuals. A2 and A8 pues would also help, but presently these don't work in MCR. Ideally the bump should produce no loss when beam is not kicked, though it may prove necessary to increase the amplitude to achieve optimal (or any) extraction.

How does one determine that beam has been extracted at D6?

1) Check for beam on hardwired PUEs (C4, D1, B2). See how much beam is left on WCM (at B6?).
    a. Ideally, want to see same intensity with and without kick on C4 and D1, with no beam on B2 after kick. Beam on WCM should also disappear after kick. Adjust bump magnets and kick (amplitude, timing) to accomplish this.
    b. Can transport to D1 be quantified using D1 PUE with and without kick? Are there saturation issues?
2) Look for beam in R line. D6 flag, ion chamber at 63 feet.
3) When (if) beam is observed there, adjust parameters to maximize (tune, bump magnets, D3, D6, radius, kicker timing and amplitude…) beam on swic at 63 ft. This may be difficult since its response to bunched beam is not well-known. If losses are visible, look on loss monitors for transmission from F3 to D6 as well.

Data:

1) SWIC profiles and scalers (at least 063), D6 flag picture of extracted beam, if any.
2) Scan booster intensity and get 063 scaler data at different intensities.
3) If relevant, measure PUE sum at D1 with and without kicking.
4) Scope dumps of relevant loss monitors.
5) Scope dumps of WCM and PUEs at time of kick.
6) Archive extraction setup
7) Booster orbit with extraction bump.